Journal of Physics: Conference Series 2006 vol.51 N1, pages 79-82

PrF3Van Vleck paramagnet as a promising material for the nuclear dynamic polarization of 3He

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Abstract

We suggest using insulating Van Vleck paramagnet PrF3 as a solid substrate for the dynamic polarization of 3He nuclei at high magnetic fields. The exploring of solid effect for this purpose assumes the knowledge of the optimal conditions for transfer of polarization from the Pr3+ electron shell in PrF3 to 141Pr nuclear spins as well as the existence of effective channel for magnetization transfer from 141Pr nuclear spins to nuclear spins of liquid 3He (so-called magnetic coupling phenomenon). To study solid effect in PrF 3 the magnetic field dependencies of the Stark energy levels of 3H4 ground state multiple were calculated for high magnetic fields up to 40 T using the set of crystal-field parameters obtained early from magnetization measurements and exchange charges model. Also the results of searching for a direct magnetic coupling between nuclei of the liquid 3He and 141Pr nuclei in the system "PrF3 powder - liquid 3He" by pulse NMR method are represented. Also the surface effects in the PrF3 crystal were studied by SQUID and optical microscopy measurements. Other aspects of the nuclear polarization transfer are discussed.

http://dx.doi.org/10.1088/1742-6596/51/1/016